ANALYSIS OF BASIC CONCEPTS IN SCIENCE TEXTBOOKS

GRADES 1 - 3

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Introduction

The study reported here is an analysis of basic science concepts as presented in several series of primary level (grades 1 through 3) science textbooks. It is intended primarily as a reference source for both developers of educational materials and primary science teachers. The analysis involved a detailed examination of all textual and pictorial material in four series of primary level science texts. The following series were included in the analysis:

a. Modern Science, Laidlow Brothers, 1970.
b. Today's Basic Science, Harper and Row, 1963.
c. Science Around You, Ginn and Co., 1958.
d. Science Far and Near, D. C. Heath and Co., 1968.

In some instances useful aids and/or potential materials development projects were readily apparent and a list of these suggestions is included in Appendix A.

Purpose

The purpose of the study was to identify the basic concept areas covered in primary science textbooks, to develop lists of related vocabulary and to assemble a series of experiments and activities which could be used to illustrate the concepts. The concept areas and the related activities have been further divided into three levels of difficulty or sophistication. While these three levels generally correspond to grade level it is not unusual to encounter substantial overlap at different grades. Concepts are included as they were presented in the texts, and not necessarily how they should have been presented. In some instances, activities have been included which were not found in the text when they offered particularly effective illustrations.

Procedure

Textbooks were analyzed by series from grade one through grade three. The first time a concept area was encountered, the area and related vocabulary and activities were recorded. From subsequent presentations of the same concept area additional vocabulary, activities, and levels of sophistication were added. This procedure was followed since it was more informative than a simple frequency count and, in addition, since there is evidence that frequency of occurrence is not necessarily a good reflection of educational significance (Franks, 1971). For this reason, one should avoid concluding that a given concept area is unimportant simply because this analysis, or the texts upon which it was based, devoted comparatively little space to that area. Frequently, two or more general concept areas shared common subject matter. Consequently, certain specific concepts and related vocabulary and activities may appear in more than one concept area. It should again be noted that both textual and pictorial material were reviewed to make the analysis as complete and comprehensive as possible.

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Concept Area: The Scientist

Vocabulary	Aids Required
experiment	soda straws
control	salt

Concepts	Activities
LEVEL I	
LEVEL II	
Scientists observe, discuss, read, perform experiments, and keep careful records.	Discuss why the scientist must perform the above activities. Have the class keep daily records of plant growth, water evaporation or temperature.
LEVEL III	
Students, like scientists, can perform experiments and keep careful records.	Compare the waterline of soda straws floating in salt solutions of various concentrations. Make a Histogram of the results of the experiment. Discuss the various instruments of the scientist: The microscope telescope thermometer hand lens, etc.
Scientists check their experiments by using a control experiment.	Discuss.

Concept Area: Temperature

Vocabulary

matter
temperature
thermometer
degrees
absorb

Aids Required

pint glass jar
tin can
thermometer
ice
pan
balloons

Concepts	Activities
LEVEL I	
The temperature of matter is how warm or cold it is. The heat from the sun warms things.	Find a sunny and a shaded area. Stand in the shady area for a few minutes. Move to the sunny area. What change in temperaturn do you notice? What causes the temperature change?
LEVEL II	
A thermometer shows temperature. A thermometer measures temperature in degrees. The temperature reading on the thermometer changes as matter becomes hotter or colder.	Measure the temperature of a pint glass jar of water from the tap. Place the jar in the sunlight for two hours. Check its temperature again. What has happened to the temperature of the water? Screw the top on a jar so tightly that it is too hard to open. Now run hot water over the cover only. Dry it. Now try to open it. Is it easier now? Why did the cover come off easily.
LEVEL III	
Matter absorbs or gains and loses heat energy causing a change of temperature. When matter loses heat energy it becomes cooler. When matter absorbs energy, it becomes warmer.	Leave a metal can of water at room temperature for two hours. Record the room temperature of the water. Replace half with cold water. How low does the temperature go? Record the change in temperature. Heat the water and notice the temperature change as the water absorbs heat energy.

Most substances expand when heated (water expands when it freezes--freeze a pan full of water)

Partially fill a balloon with air. Place it in or under hot water. It will expand. Place in cold water bath. It will contract

Concept Area: Phase Change, Insulation

Vocabulary

- liquid
- cloud
- gas
- melt
- expand
- insulation
- melting point
- freezing point
- boiling point
- thermometer
- ice
- water vapor

Aids Required

- ice
- thermometer
- glass
- pan
- jars
- paper for insulation (fur, cloth)
- 2 tin cans: one painted white; the other, black

Concepts	Activities
LEVEL I	
Energy from the sun warms things. We can use other devices to warm or cool objects.	Feel the warmth of the sun's rays or of a candle; the cooling of an ice cube or a refrigerator. Discuss the properties of solids, liquids and gases. Use water and aid as examples.
LEVEL II	
Heating (and cooling) can change the form of matter. (Snow, rain, hail, etc.) A thermometer indicates temperature of matter and shows the freezing, and boiling points. Most substances expand when heated and contract when cooled. Water does the opposite.	Fill a container with ice, insert a thermometer and place in warm water. Record the temperature periodically as the ice melts (phase change). Note the water does not fill the glass--it expands when frozen and contracts when heated. Freeze a pan filled with water and note how it extends beyond the edges of the pan. Discuss how cooking causes a phase change in foods such as eggs or chocolate.

LEVEL III

Water, ice and steam are the same substance but in different forms because of the different temperatures.

Freezing and boiling points are points of phase change.

A change in temperature can be slowed down by placing insulating material around it.

Air is a good insulator.

Discuss the effects of insulating a house. Fill 2 jars with hot water and cap tightly. Wrap one with paper very loosely and the other very tightly. Leave for 1/2 hour then open and see which is warmer.

Check items at 10 minute intervals.

Discuss why we wear more clothing in the winter and why animals with thick fur can live in cold climates.

Make a list of kitchen insulators and conductors.

Discuss why vacuum bottles can keep foods hot or cold for such long periods.

Take two tin cans, paint one white and one black. When dry, fill each with ice and place in the sun. Note how the color of the paint affects the amount of heat that is absorbed by the cans. Which color would make the coolest car?

Concept Area: The Seasons

Vocabulary	Aids Required
seasons migration hibernation evergreen thermometer thermostat axis hemisphere Tropics of Cancer and Capricorn	Globe

Concepts	Activities
LEVEL I	
What are the seasons? How are they different? A year has four seasons.	Discuss: How your activities change with the seasons. Why? sun rain snow wind
LEVEL II	
What are the seasons? How are they different? How do plants change with the seasons? How do animals change with the seasons? How do your activities change?	Discuss: heating cooling weather bird migration evergreen trees air conditioning thermometer thermostat
LEVEL III	
How are seasons different? Why are they different? Discuss: Axis tilt North and South hemisphere differences.	Inspect a globe Discuss: equator Tropics of Cancer & Capricorn Axis tilt

Concept Area: Lightening, Electricity

Vocabulary

lightening
electricity
battery
energy
vibrate
circuit
electro-magnet

Aids Required

battery
bell or buzzer

Concepts	Activities
LEVEL I	
The lightening storm is a natural display of electricity. Electricity is a form of energy.	Discuss lightening (and thunder) storms.
LEVEL II	
People can use electrical energy to do work for them. (Cook food, light, heat, cool) The battery is a supply of electrical energy which we can use.	Discuss the ways in which electricity is used in everyday living. Connect a battery so that it will sound a bell or buzzer. The bell vibrates the ear and causes a sound to be heard. Play a transistor radio. Short circuit a battery briefly and note the heat build up.
LEVEL III	
Electrical energy can be used for many additional purposes. Electricity flows in a path called a circuit. Care must be taken when working near a source of electrical current, especially household current and electrical appliances.	Construct an electromagnet and find what types of objects it will move (iron) --Trace the complete circuit. Compare it to a permanent magnet. Inspect the battery-bell circuit and note how it is a complete circuit.

Concept Area: Water Cycle, Evaporation-Condensation

Vocabulary

water-cycle
evaporation
condensation
phase

Aids Required

paper towel
overflow can
salt
ice
glasses (that can be tightly covered)

Concepts	Activities
LEVEL I	
There is water on most parts of the earth. In lakes, rivers, oceans, in the soil. Water on the land comes in the form of rain and snow. Water can get into the air by evaporating.	Examine landforms of bodies of water. Wet a strip of paper towel and check how long it takes to dry.
LEVEL II	
The water on the surface of the earth can get back into the air by evaporating. Water evaporates into the air. It changes phase.	Discuss the process of evaporation. Evaporation Experiment: Put 3 inches of water in each of 2 glasses. Tightly cover one glass. Measure the depth of water in each glass daily. Try evaporation experiments at different temperatures. Heat of the sun speeds evaporation.
LEVEL III	
Water in the air can change from vapor to liquid if the air is cooled. (over a mountain) - phase change. When large drops form, they are pulled to earth by gravity as rain and snow. This repeats and is called the water cycle.	Condensation Experiment: Place an overflow can in the refrigerator or in salt-ice bath. Observe the water droplets forming. Large drops develop and run down the edge (rain). Examine thermoform of the water cycle.

Concept Area: Compass Direction

Vocabulary

compass
direction
axis
pole
north
south
east
west
rotation

Aids Required

compass
landforms

Concepts	Activities
LEVEL I	
LEVEL II	
The earth's axis emerges at the North and South poles. The location of the poles establishes the 4 points of the compass.	Examine a globe of the earth. Note where the axis emerges. North-top; South-bottom. East, West. Examine an area map or landform and emphasize the use of directions.
LEVEL III	
Earth rotates on an axis from east to west. Day and night sequence are caused by rotation.	Use axis as a reference point. Study the rotation of a globe of the earth. Note that the sun rises in the east and sets in the west. Use a compass to find North. Face that way. South is behind. Hold out arms; right is east, left is west.

Concept Area: Magnetism

Vocabulary

magnetism
poles
permanent magnet
electromagnet

Aids Required

magnet
small nail or pin to be magnetized
other small metal objects to be attracted by the magnet

Concepts	Activities
LEVEL I	
LEVEL II	
Magnets attract things made of iron and steel. Magnets attract things because there is a field of force surrounding them. The most powerful force is at the ends (poles) of the magnet. Magnetic force may pass through many materials.	Experiment to determine which objects (substances) a magnet will attract. Observe that the strongest attraction is at the poles of the magnet. Do this by lifting objects of different weights with the pole and sides of the magnet. Attract iron objects through paper or wood or under water.
LEVEL III	
Iron or steel can be magnetized by a magnet so that they become magnetized and will attract iron. The field of force around a wire carrying electrical current will magnetize a piece of iron or steel. Dropping a permanent magnet can cause it to lose its force.	Place a small nail or pin on a strong permanent magnet and allow it to become magnetized so that it will attract other steel objects. Construct an electro-magnet. Demonstrate that the magnetism leaves when the current stops flowing.

Concept Area: Gravity

Vocabulary	Aids Required	
gravity	ball	rocks or marbles
high ground	jar	bean seeds
low ground	foil	

Concepts	Activities
LEVEL I	
Gravity pulls things down toward the ground.	Observe how objects fall to the ground when dropped or thrown.
LEVEL II	
Gravity pulls every object toward the center of the earth.	Simulate gravity-induced motion on a globe of the earth. Drop rocks or marbles into a jar of water and listen for them to hit the bottom.
LEVEL III	
Gravity is responsible for the motion of rivers and streams and the falling of rain. Plants and animals can sense the direction of gravity.	Fold a strip of foil up along the longer edges and bend into a U-shape. Pour water into one end. Note how water goes up the other side a little ways. Observe a landform with a river. Where is the high ground; the low ground? Plant bean seeds at various angles. Note how the roots always go down and the shoots up into the air. Plants are sensitive to gravity.

CONCEPT AREA: SIMPLE MACHINES

Vocabulary

work
machine
friction
ramp
wedge
energy
pulley
screw
lubrication

Aids Required

2 pieces of coarse textured wood
soap
examples of simple machines
wagon
heavy carton, dowel rods

Concept	Activities
LEVEL I	
To work requires energy.	Lift/push a heavy object.
People use machines to do work.	Discuss examples of men doing work (eg. lifting furniture)
A lever or bar is a simple machine that can be used to lift or pry.	Use a pencil to lift a book, or a screw driver blade to pry with.
A ramp is a machine.	Make ramps of different pitches.
A wheel is a machine.	See how a wagon makes work easier. Try to slide a heavy box or carton on the floor. Now try it with some rods under the box.
LEVEL II	
People can use simple machines to reduce the amount of work they do.	Lift a book up, then pry it up with a pen or pencil.
The slide in the playground is a type of simple machine, a ramp.	Push a chair without wheels; then push a chair with wheels.
A long ramp makes work easier than a short ramp.	Pull a loaded wagon up ramps of different lengths. Discuss other ramps eg. freeway approaches.
The screw is a simple machine used to lift things.	Screw jacks can lift cars or even houses. Examine a wood screw. Put a fingernail on the tip and notice how it rides up when the screw if turned.
Force is always required to use a simple machine.	

LEVEL III

A pulley is a machine that makes it easy to lift or move things.	Examine and use a fixed pulley.
A pulley is a wheel that turns on an axle.	
There are two types of pulleys: fixed and movable.	Inspect both types of pulleys.
A fixed pulley is held in place by a hook	Example is the flag pole Notice how the rope or cord goes over the top of the pulley. Use pulleys to lift common objects (eg. a book) Measurements can be taken to determine how much force is necessary.
A fixed pulley helps us lift or move something by pulling in the other direction. It does not make the load seem lighter than it is.	
The movable pulley moves along with the object being lifted. Less force is required when a movable pulley is used.	Add a movable pulley to the experiment above. Measure the reduction in force.
Friction increases work harder.	
Friction occurs when 2 surfaces rub. (like the wheel and axle of the pulley). Sometimes a squeak is caused by the friction.	Observe the friction of a pulley.
Friction causes heat and wastes energy.	Rub 2 pieces of coarse textured wood together and not how difficult it is. Note that heat is a waste of energy. Coat the wood with soap and rub together again, note the reduction of friction, heat energy, and effort.
Lubrication can reduce friction.	Oil the pulley.

Concept Area: Moon

Vocabulary		Aids Required	
revolve	moon phases	grapefruit	ping-pong balls
reflect	rotate		

Concepts	Activities
LEVEL I	
The moon is lighted by the sun. The moon is smaller, 1/5 the size of the earth. The moon is mountainous. There is no air or wind on the moon.	Compare balls, one of which is 5 times the size of the second. (Large grapefruit and a ping-pong ball.)
The moon revolves around the earth.	Discuss
LEVEL II	
Moon reflects light from the sun. The moon is heated by the sun. Earth rotates and causes the rise and fall of the moon. There is no erosion on the moon because there is no air or water.	Light probe inspect a white moon on dark background with high and low source.
LEVEL III	
What is the moon's surface like? The changing shape of the moon is due to different amounts of light that can be seen.	Light probe and tactually explore the moon model and phase sequence reporduced on thermoform.

Concept Area: Jets, Rockets

Vocabulary		Aids Required
jet rocket fuel	oxygen space	plastic models of jets & rockets balloons, string

Concepts	Activities
LEVEL I	
LEVEL II	
LEVEL III	
Airplanes carry people and goods from city to city	Discuss airplanes Examine models
Jets fly higher and faster than any other plane.	Discuss jet propulsion (expanding exhaust from burned fuel pushes the plane.) Inspect and discuss balloons as examples of jet propulsion. Make "balloon jet" to travel along string path. Listen to the sound jets make.
Rockets	Examine models. Discuss rockets and rocket propulsion. Key difference is that rockets carry their own oxygen with them to burn fuel so they can go into outer space where there is no oxygen. Discuss use of rockets and space travel.

Concept Area: Soil

Vocabulary

- clay
- sand
- gravel
- humus
- forest soil
- topsoil
- erosion
- expand

Aids Required

- soil
- Jar
- pan

Concepts	Activities
LEVEL I	
Not all soil is alike. Clay, sand, gravel, humus, forest soil are all examples of different types of soil.	Examine samples of different types of soil. Place samples of each in a glass of water. Note how some of the animal and plant matter floats on top of the water.
LEVEL II	
Soil comes from rocks that have crumbled and small pieces of plants and animals that are decaying. Lots of decaying matter makes rich soil. Earthworms affect soil. Weather affects soil. There are three soil layers.	Observe small pieces of plant and animal matter in soil.)particularly in forest topsoil) Half fill a jar with soil--add water and shake, organic matter floats. Observe earthworms in soil. They burrow in the ground and let air enter the soil. Inspect examples of each soil layer.
LEVEL III	
Rock is broken into small pieces by the action of erosion and of plant roots and expanding ice. There is air in the soil.	Fill a pan to the top with water and freeze it. Note how the ice has expanded and extends beyond the edges of the pan. Relate this to water freezing in a crevice of a rock. Place earthworms in soil overnight. Earthworms come to the top when soil is heavily dampened. Water has displaced the air which earthworms must have to breathe.

Concept Area: Erosion

Vocabulary		Aids Required
erosion	pollution	soil
soil	conservation	sod

Concepts	Activities
LEVEL I	
Good soil is necessary if good crops are to be grown. Erosion wears away this soil and ruins it for growing.	
LEVEL II	
Water and wind can move over exposed soil and wear it away. Erosion can be reduced by planting grass or other plants in the soil. This protects it from erosion. Plants help hold the water.	Lightly pack a 5 inch mound of soil. Sprinkle water on it. Note how the water wears away the soil. Repeat the experiment with soil where grass has been grown.
LEVEL III	
Farmers often plow their exposed fields in a curved pattern so that water cannot flow easily and erode the soil. Everyone ought to use the soil wisely to conserve it.	Discuss some examples of soil pollution and misuse, and how we should help conserve this natural resource.

Concept Area: Rocks, Fossils

Vocabulary

fossils
erosion
sedimentary
igneous
volcanic
limestone

Aids Required

2 rocks (coarse textures--eg. pumice)

Concepts	Activities
LEVEL I	
Not all rocks are the same.	Examine a variety of rocks for differences in size, weight, shape, texture, and buoyancy.
LEVEL II	
Rocks can change over time by: plant action weather erosion ice Crumbled rock together with other material forms soil. Some rocks contain minerals that are very valuable.	Discuss the terms presented. Examine stones from a beach or river bank. Note how smooth they are. This is an example of erosion. Rub two porous rocks together and note the small particles that come off. Try this with different pairs of rocks and notice any difference in the amount of dust produced. Discuss some valuable minerals that are found in the ground and discuss how they are mined.
LEVEL III	
Rocks vary according to how they were produced. Different types are: sedimentary igneous - volcanic metamorphic limestone from shells of small sea animals Fossils are sedimentary and contain impressions of plants and animals that lived long ago.	Examine specimens of each and note differences. Note hardness and texture differences.

Concept Area: Air

Vocabulary	Aids Required
helium deflate inflate oxygen carbon-dioxide	yardstick string balloons plumbers force-cup earthworm jars (different sizes)

LEVEL I

Concepts	Activities
The mixture of gases that surround the earth is called air. Air moves things and we can feel it. Air is all around us. Air cannot be seen. It can be felt. Wind is air that is moving. Air has weight and takes up space. Living things must have air to survive.	Blow on your hand. Inspect a deflated basketball. Inflate the ball. See what difference the air has made. Weigh the 2 balls Balance a yardstick. Tie an inflated balloon to each end. Deflate one of the balloons. What happens to the yardstick?

LEVEL II

Concepts	Activities
Wind does work. There is air in water. Fish breathe this air. Some gases are lighter than air. There is air in the soil.	Inspect a whirl-wind toy. Discuss a wind-mill. Inflate a balloon with helium and observe what happens. Fill a glass with water and place a card on top. Hold the card in place and invert the glass. Stop holding the card. (Air pressure) Press a plumbers force-cup against the wall. Air pressure holds it there. -Try to pull it off. Inspect and discuss the air-CO_2 cycle thermoform Place earthworms in a jar of soil.

Pour water on the soil. The earthworms will come to the top. The water displaces the air in the soil, and the worms need air to breathe.

LEVEL III

Air is made up of gases, mainly oxygen and carbon dioxide.

Care must be taken so that the air is not polluted and remains clean.

Discuss examples of air pollution and what the effects of air pollution can be.

Observe a fish swimming in water. The fish is alive because it can breathe oxygen dissolved in the water.

Observe a small candle burning. Place a jar over the candle. It goes out because it has burned up all of the oxygen. Fire must have oxygen to burn. Try this experiment with different size jars.

Blow into lime-water through a straw. Observe the cloudiness of the water. (light probe) The carbon dioxide in your breathe has turned the lime-water cloudy.

Concept Area: Sound, Hearing

Vocabulary

- vibration
- outer ear
- middle ear
- inner ear

Aids Required

- materials for a tin can telephone:
  - 2 tin cans
  - string
- tuning fork
- clock
- stick of wood

Concepts	Activities
LEVEL I	
Hearing is one of our senses. We hear sounds with our ears.	Close your eyes and try to identify sounds that you hear. Identify familiar sounds: water faucet door bell clock tick and alarm pencil sharpener bird driving a nail with a hammer, etc.
LEVEL II	
Sounds travel through the air. Sounds also travel through wood, steel, string and water.	Listen to a clock tick through a stick of wood. Place your ear on your desk and tap the desk. Does the top carry the sound to your ear? Make a tin can telephone. Hold a glass to your ear. The sound you hear is moving air.

LEVEL III

Sounds are produced by vibrations.
The vibrations are received by our ears and are transmitted to our brain.
The faster the vibrations, the higher the pitch.

Feel your throat vibrate when you speak.
Plug your ears and notice how your hearing changes.
Listen to a musical instrument. Can you pick up the vibrations made by the instrument.
Examine the model of an ear.
Find the:
- Outer ear
- Inner ear
- Middle ear

Place a strongly vibrating tuning fork in a pan of water.
Have the school nurse give a talk on ear care.
Place a strongly vibrating tuning fork on a piece of metal or tone-bar.

Concept Area: Fire

Vocabulary

- fire
- heat
- carbon-dioxide
- oxygen
- burn
- fire extinguisher

Aids Required

- candles
- jars (of different sizes)
- baking soda
- vinegar
- materials to make a fire extinguisher:
  - soda
  - vinegar
  - jar
  - cork
  - straw

Concepts	Activities
LEVEL I	
Energy from a fire provides heat and light. Heat from fire can be used to cook, warm, etc.	Observe a burning candle. Feel the warmth it gives off.
LEVEL II	
3 things are needed for fire: something to burn (fuel) oxygen and heat. If any are removed the fire goes out. Carbon-dioxide replaces oxygen and flame extinguishes.	Observe an unlit candle in the air (no heat). Place different size jars over burning candles and note the difference in time till the fire goes out. The large jars have more O_2. Make carbon dioxide with baking soda and vinegar. Drop in a lighted match; flame extinguishes. Repeat with empty (air-filled) jar.

LEVEL III

Discuss fire safety in the home. We must control fire so that it does no damage. The sun is a ball of fire (burning gases) that gives off heat and light.	Explain: Operation of the fire extinguisher Operation of the fire engine. How to call the fire department or operate a fire alarm. How to roll a friend in a blanket if his clothing should catch fire. Construct a fire extinguisher with soda, vinegar, jar, cork, and a straw. Use it to put out a candle.

Concept Area: Plants

Vocabulary

plant
flower
seed
root
leaves
root system
seedling
bulb
pod
terrarium

Aids Required

common examples of plants, including coleus
bean seeds, soil, bulbs
several pots, terrarium

Concept	Activities
LEVEL I	
Plants are all around.	Examine common plants.
Plants have flowers, leaves, stems and roots.	
Bees and butterflies get food from the flowers.	Discuss.
LEVEL II	
Seeds come from plant flowers.	Examine a poppy pod. Listen when it is shaken. Examine the seeds inside.
Seeds have little plants in them and have food for the little plant. They need sunshine for the little plant to grow.	Put bean seeds in water over night. Remove hard covering and look for the small plant inside.
Little plants grow from seeds and are called seedlings.	Plant a few bean seeds; water and allow to grow. Inspect seedlings.
Trees are plants	Examine common trees.
Seeds can travel on the wind or on water or be carried by animals	Examine cattail seeds, etc. Discuss
Plants need light	Plant seeds in two pots and water both. Place one in light, keep the other always in the dark. Observe.
Leaves of plants grow up to gather light.	Place pot of grass in dark for a week.
Plants need water.	Plant seeds in two pots. Water one but not the other. Keep in daylight. Observe.
Roots of plants grow down to gather water.	Inspect root system.

Big roots grow into little roots and form a root system.	
Some plants grow from bulbs. A bulb is a kind of seed and there is a little plant inside.	Inspect bulbs.
The bulb has food for the little plant inside.	
Sometimes, whole plants can grow from a small piece of cutting of a plant.	Place coleus cutting in water and observe plant which develops.

LEVEL III

Plants and animals living in the same area make up a community. A pond and a meadow are communities.	Discuss the types of plants found in a meadow or pond.
A terrarium is a place where plants and animals live together.	Make a terrarium and observe the plants growing.
Plants take carbon dioxide from the air and put oxygen back. They provide animals with shelter and food. They help keep the soil rich.	Discuss
Some plants live in water.	Inspect and discuss algae.
Mold is a plant that does not have roots, stems, or leaves.	Inspect and discuss mold.
Mold cannot make its own food.	See if mold grows in a terrarium. It can be controlled with slaked lime.
Mold grows in warm, damp, dark places.	Grow mold on a slide of wet bread that is placed in a dark location. Try the experiment with dry and toasted bread with wet bread in the refrigerator, with bread under water.

Concept Area: Animals

Vocabulary

animals
insects
egg
emphibians
hibernation
caterpillar
chrysalis
butterfly
mold
reptiles
mammals
aquarium

Aids Required

Aquarium and related supplied
Common animals

Concept	Activities
LEVEL I	
There are many kinds of animals. Some are very different. Some are very similar.	Discuss and Inspect some animals (eg) dog, insect, lizzard, cat.
LEVEL II	
All animals need for to live and grow. Some animals eat plants. Some animals eat other animals. Some animals eat both. Animals have to catch or gather food. Animals change as they grow: (metamorphosis is also separate concept area). Some animals are called mammals Their babies are born alive. They get milk from their mother. They have hair. Fish are animals. Reptiles are animals. The amphibians are an animal. Insects are animals (insects have a separate concept area)	Discuss and find examples Discuss: spiders, dogs, insects etc. Discuss changes in birds and insects a s they develop Examine and discuss examples of mammals. Discuss the life of the beaver. Inspect a fish. Build an aquarium Inspect and discuss the turtle. Inspect a frog and discuss its development Inspect insect models

LEVEL III

Plants and animals live together in a community such as a pond or meadow. Hibernation is when animals sleep all winter. Some insects are pests and must be controlled	Discuss and examine animals found in a meadow or pond. Collect frog eggs and observe them as they develop into frogs. Discuss common examples of animals that hibernate. Discuss development of mosquitoes and mosquitoe control.

Concept Area: Insects

Vocabulary		Aids Required
insects	metamorphosis	Insect models
butterfly	pollenation	
bee		

Concept	Activities
LEVEL I	
Insects are living things.	Inspect models of common insects. Discuss how they are alike or different.
Insects are animals.	
LEVEL II	
Some insects (butterfly, bee) get food from flowers.	
Insects need food to grow.	Discuss feeding methods of bees.
Insects change as they grow. Some grow from eggs (metamorphosis is a separate concept area).	Discuss development of butterfly.
LEVEL III	
Insects are found in all parts of the world.	Inspect a wide variety of insects.
Some insects have bright colors.	Discuss
Some can make a light.	
Some insects are helpful.	Discuss bees, silkworm.
Some insects are harmful.	Discuss termites, mosquitoes.
All insects are alike in certain ways.	Inspect ant, grasshopper.
Every insect has three body parts. head, thorax, abdomen.	Discuss and relate function of each part.
Every insect has one pair of antennae, sometimes called feelers.	Discuss function.
Every insect has six legs.	
Every insect has two pairs of wings.	
Insects have their skeleton on the outside (shell) instead of on the inside like most animals.	
Spiders are not insects.	Discuss how they are alike and different Make an insect zoo.

Insects change as they grow.	Discuss.
This is called metamorphosis.	
Metamorphosis means to change in form.	
There are four stages in metamorphosis. (Metamorphosis is a separate concept area).	Discuss development of butterfly.
Some insects are very unusual.	Discuss the praying mantis.
Bees pollenate flowers and are very helpful.	Discuss.
Ants are interesting and hard-working insects that live in a colony.	Discuss.

Concept Area: Metamorphosis

Vocabulary

metamorphosis
caterpillars
chrysalis
pupa
migration
tadpole
larva
molting
cacoon
moth
nymph

Aids Required

eggs of different insects
frog eggs
insect models

Concepts	Activities
LEVEL I	
Some young animals do not look like their parents.	Observe frog's eggs, insect eggs, etc., and the adults of each specie. Note the differences.
LEVEL II	
Many animals change as they grow. A good example is the butterfly. Many changes are related to the seasons. Life cycle of the butterfly. Different foods are needed at various stages of development	Observe caterpillars, chrysalis models of the adults. Show how the insect changes as the seasons change. Discuss: monarch migration
LEVEL III	
The change that insects go through is called metamorphosis. Metamorphosis means change in form. There are four changes in complete metamorphosis	Trace lift cycle of cecropia moth. Discuss eggs, larva, caterpillar, molting, pupa, cacoon, moth. Discuss life cycle of mosquitoe.
Some insects go through an incomplete metamorphosis with only three stages.	Discuss development of grasshopper.
Other animals also go through metamorphosis.	Discuss the lift cycle of the frog. Inspect at the various stages of development.

Concept Area: The nose and mouth

Vocabulary		Aids Required
mouth	baby tooth	models of nose and mouth
nose	tongue	

Concept	Activities
LEVEL I	
LEVEL II	
Water, food and other things go into the mouth. They should be clean.	Discuss. Inspect model.
We taste with the tongue.	
There are teeth in the mouth.	Inspect model.
LEVEL III	
There are baby teeth and permanent teeth.	Discuss.
You breath through your nose.	Discuss.
We smell things with the nose.	Inspect model.
Take care of your nose.	Discuss.
Be careful how you blow it.	

Concept Area: The Eye

Vocabulary		Aids Required
eye	pupil	model of the eye.
iris	eyeglasses	

Concept	Activities
LEVEL I	
We see with our eyes.	Discuss
Eyes have different colors.	
LEVEL II	
Eyes have different shapes.	
All eyes work the same way.	
The colored part is called the iris.	Inspect model of the eye.
The dark part in the center of the iris is called the pupil.	
The pupil can change size.	Discuss light and dark adaptation. Observe pupil in light and dark conditions.
The doctor helps us care for our eyes.	
Some people have to wear eyeglasses.	Discuss.
Take care of your eyes.	Discuss eye care.
LEVEL III	

Concept Area: Skin

Vocabulary

skin
pores
pigment
sweat
sweat glands
sense organ
epidermis

Aids Required

sandpaper
model of skin, cross-section

Activities

LEVEL I

Your body is covered by skin. Skin is sensitive to touch, warmth, cold, pain and pressure.

Examine various objects to see how much you can learn about an object just by touch. Pay particular attention to surface textures.

Experiment:

Place one hand in ice water and one in very warm water; then place each in a pan of water at room temperature, one at a time.

--The skin sensation is dependent upon the relative temperature of the skin.

--Discuss how this affects what one considers to be warm or cold.

LEVEL II

Skin is important. It keeps germs and dirt outside the body. It also tells you when you have touched a hot stove or when it is cold enough to wear a coat. The skin has pores to let body heat escape when you are too hot. The skin has sweat glands in the surface that give off a liquid called sweat to help you cool off.

The pores close and save body heat when it is cold out.

Other animals have skin too. Some have fur to help save body heat. Birds have feathers for the same reason.	Examine specimens of the above mentioned animals. Examine thermoform of skin cross-section.
Earthworms have soft moist skin. They breathe air right through their skins.	Take a piece of sandpaper and rub your fingertip across it. Now rub the flat part of your fingernail across it.
Snakes have skin that has scales like your fingernails. This helps them to crawl along the ground by reducing friction.	Having skin like this helps the snake move because it reduces friction.

LEVEL III

Your skin grows as you grow.	
The skin is made up of layers.	Inspect model of skin.
The outer layer is the epidermis.	Observe skin under a hand lens.
Skin is made up of cells.	
A cell is the smallest whole part of any living thing.	
The middle layer of skin is called the dermis.	Discuss functions. Inspect.
The skin gives off oil to keep itself healthy.	Feel the oil at the side of your nose. Discuss.
The skin regulates body temperature. Sweat glands give off liquid (sweat) when body temperature rises.	Discuss.
Evaporation of sweat cools the body.	
When the body is hot, the pores open to release heat. At other times, the pores are closed.	Discuss.
One should wash regularly to keep the skin clean and healthy.	Discuss.
There are cells in the skin that give it color. This is called pigment and is brown in humans.	Discuss differing amounts of pigment in different people.
Sunlight makes the pigment cells active and turn the skin brown.	Discuss.
Too much sun can be harmful.	
The skin sends 5 kinds of signals to the brain: touch, pressure, pain, heat, cold, and is called a sense organ.	Discuss these sensations.
Skin messages protect the body from extreme temperatures and warn of injury.	Discuss.

The skin on fingertips has a series of ridges called fingerprints.	Discuss identification through fingerprint analysis.
No two people have the same finger print.	Make your own fingerprints with printer's ink.
Ridges on the foot are also used for identification, particularly with babies.	Compare your fingerprint with those of your classmates.

APPENDIX A

Suggested Aids and Materials

In the course of the analysis reported here, the need for a number of aids which are not currently available or which are not widely used became evident. Below is an annotated list of these materials.

a. light probe: an audible photoconductive light probe, such as the one available from the Royal Institute for the Blind (catalog no. 9432) would be very useful in such areas as astronomy or space science where light reflection or the presence or absence of light are essential to concept attainment. The light probe offers even greater potential at grades above the primary level. Increased use of the light probe was strongly recommended by the Institute on Instructional Materials Development in Science for Visually Handicapped, held at the American Printing House for the Blind, Louisville, Kentucky (Franks, 1970).

b. soil cross-section: a model illustrating the three layers of soil: topsoil, subsoil, bedrock.

c. topsoil cross-section: showing earthworms and their tunnel network.

d. moon model: model of the moon designed to facilitate tactual inspection.

e. moon phases: showing the moon in six phases: new, crescent, first quarter, second quarter, third quarter and full. Raised and differentially textured for tactual inspection, a white on black color scheme would facilitate visual and light probe inspection.

f. water-cycle

g. skin cross-section: showing layers of skin and important structures.

h. plant models: illustrating a variety of plant species. Also needed is a model of a plant showing root system, stem, and leaves.

i. plant life-cycle model: illustrating the various stages in plant development (eg. seed to mature plant). Perhaps more than one species of plant could be so modeled (eg. life-cycle of mold).

j. insect models: illustrating the distinguishing morphological features of insects and perhaps involving a comparison with other small invertebrates such as the spider or the earthworm.

k. metamorphosis: model illustrating the life cycle of the butterfly, the mosquitoe and the frog.

l. thermometer: a model or simplified representations of the APH thermometer, designed to teach the operation and use of the thermometer at the primary level.

m. ruler: a model or simplified representation of the APH ruler, designed to teach the use of the ruler at a primary level.

n. simple machines: a set of simple machines which are straightforward enough to be used and understood by the primary level student.

In addition it is recommended that immersion heaters not be used or included in any materials laboratory. Immersion heaters do not have sufficient capacity to heat even moderate quantities of fluids and the recognized dangers of severe burns and electrical shock make the use of such devices extremely unwise.

REFERENCES

Franks, F. L. Instructional materials development in science for visually handicapped. Unpublished Institute Report, American Printing House for the Blind, 1970.

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